ERIC CYTRYNBAUM, University of British Columbia, Department of Mathematics
Finding the center—how to solve simple geometry problems at the cellular scale

Fragments of fish melanophore cells can form and center aggregates of pigment granules by dynein-motor-driven transport along a self-organized radial array of microtubules (MTs). In this talk, I will present a system of integro-differential equations that model pigment aggregation and MT-aster self-organization and the subsequent centering of both structures. The model is based on the observations that MTs are immobile and treadmill, while dynein-motor-covered granules have the ability to nucleate MTs. Scaling arguments and perturbation theory allow for analysis in limiting cases. This analysis explains the mechanism of aster self-organization as a positive feedback loop between motor aggregation at the MT minus ends and MT nucleation by motors. Furthermore, the centering mechanism is explained as a global geometric bias in the cell established by spontaneously nucleated microtubules. Numerical simulations lend additional supports to the analysis. The model sheds light on role of polymer dynamics and polymer-motor interactions in cytoskeletal organization.